Make A Comet And Eat It!

DESCRIPTION
In this activity, students develop a comet model that can be eaten and trade another "comet" on which to take measurement using four senses.

OBJECTIVES
Students will:

- Investigate the physical characteristics of comets
- Compare their ideas about comets with the data that NASA comet missions have sent back to Earth
- Develop a comet model

NASA SUMMER OF INNOVATION

UNIT
Earth and Space Science – Year of the Solar System

GRADE LEVELS
4^{th} – 6^{th}

CONNECTION TO CURRICULUM
Science and Technology

TEACHER PREPARATION TIME
2 hours

LESSON TIME NEEDED
1.5 hours *Complexity: Moderate*

NATIONAL STANDARDS

National Science Education Standards
Science As Inquiry

- Understanding of scientific concepts
- An appreciation of "how we know" what we know in science.

Physical Science Standards

- Properties of objects and materials

Earth and Space Science Standards

- Objects in the Sky

Science and Technology

- Abilities to distinguish between natural objects and objects made by humans.

ISTE NETS and Performance Indicators for Students (ISTE)
Communication and Collaboration

- Interact, collaborate, and publish with peers, experts or others employing a variety of digital environments and media
- Contribute to project teams to produce original works or solve problems

MANAGEMENT

Materials need to be purchased fresh and kept in store-brought containers. Anything that is used to measure, hold or eat with/out of should never have been used for any classroom chemical storage.

A mop and sponge is helpful for desks or floor areas where measuring is done. Consider pre-loading ice cream bags and salt bags at home.

The ice needs to be either freshly bought or well frozen in storage. The container for transporting and storing the ice should be pre-cooled if possible or very efficient. If the ice has “warmed”, it will be difficult to get the milk/cream to solidify.

CONTENT RESEARCH

- Comets are in **orbit** around the Sun as are our planets.
- Comets are composed of ices, dust and rocky debris carried from the early formation of the solar system about 4.5 billion years ago.
- Comets are remnants from the cold, outer regions of the solar system. They are generally thought to come from two areas - the **Oort Cloud** and the **Kuiper Belt**. Both of these are areas where materials left over from the formation of our solar system have condensed into icy objects. Both regions extend beyond the orbits of Neptune and Pluto but are still part of our solar system and much closer to us than the closest star.
- Comet orbits are **elliptical**. It brings them close to the sun and takes them far away.
- **Short period** comets orbit the Sun every 20 years or less. **Long period** comets orbit the Sun every 200 years or longer. Those comets with orbits in between are called Halley-type comets.
- Comets have three parts: the **nucleus**, the **coma** and the **tails**. The nucleus is the solid center component made of ice, gas and rocky debris. The coma is the gas and dust atmosphere around the nucleus, which results when heat from the Sun warms the surface of the nucleus so that gas and dust spew forth in all directions and are driven from the comet's surface. The tails are formed when energy from the Sun turns the coma so that it flows around the nucleus and forms a fanned out tail behind it extending millions of miles through space.
- We see a comet's coma and tail because sunlight reflects off the dust (in the coma and dust tail) and because the energy from the Sun excites some molecules so that they glow and form a bluish tail called an ion tail and a yellow one made of neutral sodium atoms.
- Scientists have seen comets range in size from less than 1 km diameter to as much as 300 km, although the 300 km (called Chiron) does not travel into the inner solar system.
- We know a comet could impact Earth and that it is important to understand the nature of comets so we can design better methods to protect ourselves from them should one be on a collision path with Earth.
- A comet nucleus has a dark, sometimes mottled surface but we don't know if it has an outer crust or if it is layered inside. We don't really know what comets are like beneath their surface, which is why we need a mission like **Deep Impact**.
- A variety of instruments and cameras onboard comet-exploring spacecraft collect data for scientists to later analyze in the laboratory. Spectrometers help scientists determine the chemical composition of the comet and comet tails, while cameras provide close-up pictures. The Stardust spacecraft even collected a sample of a comet’s tail, and sent that sample back to Earth in a special container.

LESSON ACTIVITIES

Comet On A Stick
In this activity, you are going to develop a comet model that you can eat. You'll trade "comets" and pretend to be an instrument on the Deep Impact Spacecraft called a **spectrometer**. You will use four of your senses individually to decide what is in the ice cream.
http://solarsystem.nasa.gov/deepimpact/educ/IceCream02.html

ADDITIONAL RESOURCES

- Consider This-
  This page shows the history of perceptions about comets.
  http://deepimpact.umd.edu/educ/ExploringComets03.html

- A Comet's Place in the Solar System- A little history about where comets originate.
  http://deepimpact.umd.edu/educ/ExploringComets04.html

- Small Bodies Missions- Information about Deep Impact and other missions to comets.
  http://deepimpact.umd.edu/science/smallbodies.html

- C-O-M-E-T-S –A comet acrostic. Good for younger students or as a quick reference.
  http://solarsystem.nasa.gov/deepimpact/educ/CometAcrostic.html

MATERIALS

- One sandwich size re-closable plastic bag per team of 2 - 4
- One Gallon size re-closable plastic bag per team of 2 - 4
- Small cups for ice cream - one for each person on the team. Two additional cups are needed to trade with another team - one to "feel only" and one to "taste, smell and look at".
- Plastic spoons for everyone
- Pairs of rubber kitchen gloves, oven mitts or have them use cloths or sweaters (The comet bags get cold!!)
- Ice (enough to fill a gallon size bag 1/2 full per team) - or bring in fresh snow from outside.
- Chunky cookies in black or brown, crushed candies (like toffee or peppermint), gummy bears, coconut flakes and peanuts
- Whole milk (2% won't work)
- Sugar
- Vanilla extract
- Evaporated milk
- Salt
- Can opener
- Something to use to crush cookies and other additives

DISCUSSION QUESTIONS

- What do you know about comets? *Answers will vary*.

- What comets have been visited by spacecraft, and what information about the comets did those spacecraft send back to Earth?: *Comet Wild 2, Comet Temple 1, Comet Hartley 2, Comet Borrelly, Halley's Comet, Comet Giacobini-Zinner, Comet 2006P1, Comet Hartley. We now know much more about the shape of the nucleus of some comets, the chemical composition of the nucleus and tail, and the rotation period of the nucleus, among other things.*

- Have you ever seen a comet? *Answers will vary*.
- How do spacecraft take measurements on comets? Comet-exploring spacecraft contain a variety of instruments and cameras, such as narrow-angle cameras, mass spectrometers, dust detectors, photopolarimeters, and plasma experiments instruments. The Giotto comet spacecraft contained 10 instruments and cameras.

ASSESSMENT ACTIVITIES

After students finish making their comet, have them complete the Student Research Data Sheet
http://solarsystem.nasa.gov/deepimpact/educ/IceCream03.html
Have them answer the following questions:

- What visual observations do you make about your ice cream comet? Diagrams can be drawn also. *Answers will vary.*
- Take the "feel only" cup. Don't taste this one. What are you able to tell by using your fingers to feel the ice cream comet? *Answers will vary.*
- What are you able to tell about your sample comet using only your sense of smell? *Answers will vary.*
- What are you able to tell about your sample comet adding your sense of taste? *Answers will vary.*
- What explanations do you draw about the composition of your comet? *Answers will vary.*

ENRICHMENT

- **Comparing Comets:**
  In this activity, participants will play the role of a cometary scientist, observing and comparing the surfaces of two comet nuclei from close range.
  http://epoxi.umd.edu/pdfs/Comparing_Comets_SA.pdf

- **Comet Lingo Bingo:**
  Students read The Comet Chronicle-a fun comet tabloid written to provide basic understanding of comet science and a background of NASA's past and ongoing explorations of comets
  http://epoxi.umd.edu/4education/index.shtml

- **Comet Gallery:**
  A nice collection of pictures and videos from the NASA comet mission, DEEP IMPACT.
  http://solarsystem.nasa.gov/deepimpact/gallery/index.cfm

- **Deep Impact Ed. Page:**
  Lots of puzzles, games, and more activities dealing with comets.
  http://solarsystem.nasa.gov/deepimpact/educ/index.cfm